VACCINATION SYSTEMS OF INDIA.

BY

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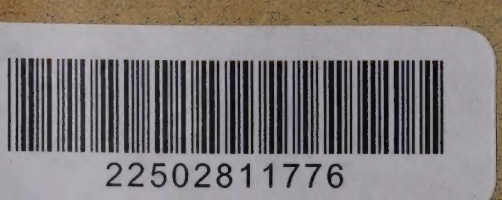

"VACCINATION SYSTEMS OF INDIA."*

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Among the numerous contributions on scientific subjects, which will be brought up before this the first Indian Medical Congress, the subject matter of this paper will in all probability be looked upon as one of minor importance, and so it is in certain respects; for we have it on the authority of no less a person than Sir John Simon that "all that belongs to the mere manual trick (of vaccination) is learnt from a minute's teaching and an hour's practice, but not so easily the philosophy of the procedure or the precautions which are necessary to make it harmless and useful." The latter part of this dictum is conveniently overlooked, and it is generally assumed that any old woman can vaccinate. There is of course a germ of truth even in this taunt; for was not inoculation for small-pox originally practised in Eastern and Southern Europe by old women, and is not ours one of the few departments, which still continue to admit men into service regardless alike of the general spread of education and of their capacity to appreciate the importance of the work they would have to do? My apology for trespassing on the valuable time of the meeting with an elementary subject of this nature is to be attributed rather to its selection by the committee than to my partiality for it, or to an exaggerated estimate of its importance, engendered by several years' experience in the Department, both as an executive officer and teacher. It may be that in the case of the profession, no less than in that of the general public, long familiarity with the "rite" has bred contempt for it, and it is just possible that this contempt has given rise to more or less carelessness in the attention to details,—the "philosophy of the procedure," as Sir John Simon calls it,—which, however, simple

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* Read before the Indian Medical Congress.

and insignificant in themselves, cannot in their totality be disregarded with impunity. If, therefore, the respite afforded by a discussion of this common place subject should add to the zest of a healthy assimilation of more weighty and abstruse scientific topics, this paper would still have served some useful purpose.

2. A general survey of the different systems of vaccination prevalent in this country, means simply a review of the different Provincial Reports on the subject, for actual observation of the results of the operation, which really affords the only criterion of the value of vaccination, means a tour of inspection through the whole country,—which is obviously an impossibility.

3. It is proposed to treat the subject in its *technical* as well as in its *administrative* aspect. But before doing so, it would be worth recalling to mind the fact that vaccination was introduced into this country, via Bombay, as far back as May 1802. The circumstances connected therewith are matters of history; how, for instance, Jenner failed to induce the Government of that day to carry out his proposal of sending the vaccine by means of a series of vaccinations, and how Dr. DeCarro of Vienna then sent charpie soaked in lymph by land, thro ugh Turkey and the lin of deserts, to Bagdad. Since then nothing is heard of vaccination; probably, owing to the disturbed state of the country, it did not receive much encouragement. The earliest record available in Bombay dates only frome the year 1848, the number of operations being only 5,266. In striking contrast with the present attitude of collegiate institutions towards vaccination, it is well to remember that in those days vaccination was done by the college staff. This is at least true of Bombay.

4. The *technical* aspect:—This involves a consideration of (*a*) the lymph in use, (*b*) the methods of operation, and (*c*) the results in their bearing on the incidence of smallpox.

5. (*a*) *Lymph*:—Concerned as we are with the existing modes of carrying on vaccination in this country, no object can be served in discusssing the more abstruse questions, which, since the days of Jenner have surrounded the causal relation between cow-pox and small-pox, and the possibility of permanently attenuating the virus of the latter by passing it through the body of the cow. Members of the Congress must have read the interesting communications made by Copeman, Voigt and Kent on this subject, which lately appeared in the *British Medical Journal*. Although the matter is still unsettled, the experiments of these nvestigators unmistakably indicate the direction in which a solution of

the mystery, which hangs round the whole subject, is to be looked for and it is most gratifying to find that among those, who have contributed to its elucidation are the esteemed Presidents of two Sections of the Congress. The bulk of vaccination in this country is carried on with humanized lymph and extended direct from arm-to-arm or by lymph in capillary tubes or even by softened scabs. Although the Administration Reports, one and all, contain expressions of hope that animal vaccination might be adopted to the exclusion of humanized lymph, it is only in Berar and Assam, that it has entirely replaced the arm-to-arm system. The Reports for 1892-93 which are the latest to hand, also show that 93 and 76 per cent. of the work in the Punjab and Madras Presidencies respectively is done with animal lymph, and it is to be presumed that by this time both the Provinces have entirely stopped the use of humanized lymph. In Bengal, N. W. Provinces, Central Provinces, Burmah and Bombay, however, the arm-to-arm system continues in vogue to a large extent, supplemented occasionally with animal lymph. How much of this state of things is due to unavoidable causes, it is of course impossible to say. But some high sanitary officers consider that "Vaccination by fresh lymph from arm-to-arm is the safest and best system of operation and affords the maximum protection against smallpox;" while others are opposed to Animal Vaccination on the principle that "the cultivation of lymph should be encouraged *only* at certain centres where sanitary and veterinary precautions can be rigorously carried out." It is needless to say that in the hands of capable men, both systems can be advantageously employed as occasion requires. So far as the "manual trick" is concerned, the Jennerian system of operation is simplicity itself. The same, however, cannot be said with respect to the selection of lymph; on the other hand, animal vaccination, while it has the great advantage of producing a large quantity of lymph of uniform quality within a comparatively short time, is hampered with details which, I fear, it is not possible for the vaccinators of the type we now have to carry out carefully on their own responsibility.

6. But animal lymph used in the various Provinces differs as much in its character, as in the mode of its cultivation. Thus, for instance, the lymph used in the Punjab is entirely cultivated in the buffalo; the same animal is very often used in the Central Provinces and Berar; but elsewhere the vaccine comes from the cow-calf. Again, the animal lymph used in the Punjab and Berar is "fresh," the vaccination in the villages being done from calf-to-arm; while in Assam it is exclusively "preserved," and in the Madras Presidency both the "fresh" and "preserved" kinds are used. But there is yet another peculiarity. Except the strain cultivated in Bombay, and perhaps in Madras, I would hesitate to say whether true bovine lymph exists anywhere in the country. While

opinions expressed by the Sanitary authorities in the Southern Presidency would lead to the belief that they have no faith in the theory which makes retrovaccination imperative, as an adjunct to animal vaccination, everywhere else it is avowedly Retrovaccine, which is passed off as animal lymph, regardless of the principle, that in true animal vaccination the strain for purposes of cultivation never leaves its natural soil. The retrovaccinists apparently base their action on the writing of the late Surgeon-Major Barclay, but the respected President of this Section will tell you that, according to some veterinary authorities, such as Peuch and others, retrovaccine tends to degenerate more rapidly than the pure bovine strain and that, moreover, retrovaccination is not nearly so fashionable in Germany and Prussia as Dr. Barclay's pamphlet led us to believe. Apart, however, from the question of the generic connection between vaccinia and Small-pox, and in view of the hypothetic origin of vaccinia itself, the only scientific method of regenerating vaccine would be in the direction of Equination as suggested by Surg.-Lt.-Col. O Hara! Was not the first supply of lymph, which came to this country, of this nature ? At any rate it might have been presumed that cultivation of vaccinia would be limited to the bovine species at least, but ingenuity has been strained in order to strike out new fields for it, and the buffalo, the donkey, sheep and goats, have all been requisitioned for the purpose, and, as was to be expected, with varying results. It would seem as though any domesticated quadruped was good enough soil for the cultivation of vacccinia; it is curious that the canine and feline pets have hitherto escaped. The buffalo has been preferred in some quarters, because, it is said, vaccinia develops better therein than in the cow; unless the nature and habits of the beast vary in the different Provinces, there should not be much difficulty in choosing between the two, keeping in view the wallowing propensities of the former.

7. While the genesis of the variolæ vaccinia is still the subject of discussion, chiefly in its practical aspect, and the advantages of animal vaccination are being slowly recognized in this country, the exponents of the latter have been making strenuous efforts to simplify this system of vaccination and enlarge its sphere of usefulness by recommending the extensive use of "preserved lymph." The Medical profession is nothing if not contentions and the difference of opinion among doctors is a phenomenon, which has now ceased to excite wonder. And it is exemplified in the present case in this way : while *scabs* or crusts from the arm are used for vaccination purposes in some parts, they are strictly prohibited in others ; while a varied experience shows the desirabiliiy of encouraging the use of "preserved lymph," as an economic factor in animal vaccination, we find that some sanitary authorities unreservedly condemn it, as possessing less protective power against smallpox than the *fresh* lymph derived in the arm-to-arm system ; and others, again, look upon

it as, at best, a diluted stuff, and do not see the necessity for using it so long as the fresh and pure material can be got in any desired quantities. With respect to the *excipient* also, the same difference of opinion exists; our esteemed President, who after much labour discovered the superior preservative properties of Lanoline over other drugs, and whose numerous experiments, as well as those of several others, demonstrated the fact, of course, considers Lanoline as the only medium at present known suitable for the preservation of lymph in this country. On the other hand, the system of preservation carried on at Madras upto last year at least, as also the method at present in vogue at the Shillong Depot in Assam and at Rangoon and other Depots in Burma, shows that glycerine is as good as Lanoline, and has the advantage of longer usage. Dr. Dobson, in one of his Reports on the Shillong Depot, brings forward the following points in favour of "glycerine lymph":—(1) It keeps much longer than the Lanoline paste; (2) the scarification on the child's arm does not require to be so deep, as "glycerine lymph" is more fluid, soaks in better, and is more readily absorbed; and (3) the lymph does not require to be rubbed in so forcibly. Against this opinion of an officer, who speaks from a fairly large experience acquired at a Depot which supplies annually nearly 240,000 tubes for the entire vaccination of a Province, and endorsed also in unmistakable terms by another at the Madras Depot, to say nothing of its having been originally advocated by Müller, Warlomont, Buist and others, and its extensive use at the present day in Germany, France and elsewhere in Europe, we learn that in Bengal the "glycerinized lymph" is condemned on account of (*a*) the rapid loss of its activity, (*b*) its "ichorus" look, (*c*) its being a fluid medium wanting in homogeneity and uniformity of strength and concentration, and (*d*) the belief that glycerine is a nutritive medium for the growth of putrefactive and other pathogenic germs, rendering the preparation septically dangerous. The majority of the sanitary authorities, however, appreciate the value of lanoline paste, which undoubtedly keeps active for some weeks; but very few seem anxious to introduce it. One authority thinks it looks like fat, and people would object to it, another considers that in his province the pure lymph keeps well long enough for all practical purposes in capillary tubes, a third thinks it would be a retrograde step to take to preserved lymph while calf-to-arm vaccination is well appreciated and is cheap; while others, again, think that calf lymph, whether fresh or preserved, cannot be effectively and safely used as a general medium of vaccination, unless it is looked after in a properly equipped institution and under specially trained professional supervision. But whatever may be the difficulties in the way of the spread of animal vaccination from the economic or administrative point of view, it would appear that the Indian public generally do not regard it with disfavour. Judging from Bombay experience, the great drawbacks of animal vaccination are its

expensiveness, and waste of material. In Bombay, where it has been exclusively carried on under the ægis of a Compulsory Act for the last 17 years, the average cost for the last triennial period, per successful case, was Rs. 0-14-9, and yet the net cost of each animal was not more than Rs. 3. The poor condition of cattle generally makes it necessary to keep a large live stock in hand with all its attendant expenses; and casualties swell the outlay. Again, a large quantity of precious lymph is often literally wasted owing to want of a sufficient number of children. With all deference to the opinion of the President, who is now a recognized authority on the subject, I would ask whether the instinctive abhorrence for the use of a material, "which varies in consistency from a thin pultacious or syrupy fluid to a semisolid fat, and the dislike for the method of operation, requisite for all vaccinations performed with preserved lymph, are not factors to be reckoned with in view of the physical condition of native children generally, and of the suspicious nature and deep rooted prejudices of the people of this country? Of course a suitable scarifier, and a little practice may facilitate the operation in course of time; but, I would, again, respectfully ask if there are no lurking dangers in the use of a forked instrument, to say nothing of the violent inflammation and its sequela produced by large wounds on the arms of thin and weak children, who constitute the majority of the infant population of this country? Even in the operation by multiple punctures lately introduced in the Western Presidency, the fall of the scab is often much delayed, and when the habits and customs of the people, and the delight (which partakes of a religious observance) they take in smearing the vaccinated part with oil, ashes, and stuffs of sorts, are taken into consideration, it may be easily conceived what possible consequences supervene. Again, granting that the lanoline paste remains sweet for some time, what is the guarantee that any little defects in the preliminary procedure, or other accidental circumstances subsequently, will not produce changes which, although invisible to the naked eye, may bring in a train of unlooked for results? The experience of its use in many thousands of cases may be brought forward in evidence of its innocuousness—at best a negative virtue; but who can vouchsafe for the after history of the vaccinated children? I hope I may be pardoned for saying that complaints of the nature we are discussing are seldom, if ever, likely to reach the ears of the authorities in this country. In connection with the universal use of preserved lymph, which its advocates urge upon the Government, it must not be forgotten that the vaccinator's duties will be made so easy and simple, that in the natural course of evolution he will lose what little knowledge he now possesses as to the selection of lymph, and, already as we are deploring the existence of a system, under which an illiterate and ignorant class of men find a refuge in the Sanitary

Department, we may have hereafter to deal with even an inferior set of men.

8. The encouragement given to the extension of animal vaccination and the progress which it has been making hitherto gives us hope that, before long, it will be the only system in universal practice in this country. It may be, therefore, not uninteresting to glance a little at the salient features of the systems of animal vaccination at persent in operation in the different provinces. *Imprimis* it would be as well to state that animal vaccination was introduced into Bombay by Brigade-Surgeon Blanc, who inocculated the first calf there on the 19th December 1869, in Calcutta it was introduced about the year 1880, in Madras in 1879, in the Punjab in 1885-86, at Mandalay in Burma in 1888, at Shillong in Assam in 1890, and in the Central Provinces prior to 1890. As already stated the method of cultivation resorted to in most of the depots, is retrovaccination, complete as in the Central Provinces, Berar and Assam, and partial, as in Bengal, Burma, and the Punjab. It is, however, to be regretted that the description is generally too meagre to enable one to do more than conjecture the precise methods adopted. Where detailed reports of the working of depots are appended, the accounts, if not very instructive, are at least sufficiently interesting. Thus, we find that, at the Darjeeling Depot in Bengal the inoculation of calves is done by a modification of the German and Brussels systems, and runs a retarded course, and is often followed by the development of *secondary* vesicles, a phenomenon which I have seen only *twice* during my experience at Bombay. Lymph used to be preserved in 4 forms,—viz. (1) simple lymph, sealed in capillary tubes, (2) simple lymph stored in capillary tubes, but sealed at either end, (3) glycerinized pulp and (4) lanolized pulp. The first two kinds which keep active only for 1 or 2 days, as well as the third, have now been discontinued; and lanoline paste alone is now manufactured and distributed. At the Shillong Depot, in Assam, humanized lymph is used every two days in calf inoculation. The solid vesicles *without the serum*, which is believed to act injuriously on the stuff are thoroughly pounded with a mixture containing two parts of glycerine to one of deistilled water, and stored in capillary tubes, and hermetically sealed; the storing is a very tedious process. It may be stated here that the late Dr. Barclay advised that both the liquid and solid parts should be used. How Dr. Dobson secures the vesicles without the serum is not clear; it seems like "taking the pound of flesh without a drop of blood." I have used the preparation on two or three occasions but without much success. In Burma at the largest Depot, which is looked after by the Health Officer at Rangoon, inoculation is done by means of "bovine scabs" and humanized lymph, the scabs being dissolved in a mixture of glycerine and distilled water. Glycerine paste is in fashion, lanoline paste being regarded as uncertain in its effects; and bovine scabs carefully preserved are considered to be

vastly superior. At Pachmari, the principal Depot in the Central Provinces, the necessity for keeping a cattle farm is not felt, nor even one for the purchase of calves!! Calf-to-calf inoculation is not carried beyond the fifth generation, humanized lymph being used to renew the stock. Lanoline paste is prepared in the proportion of 1 to 5 parts, and sent out in pill-boxes! But besides the Depot, a general system of animal vaccination has been introduced into the villages, the inculation of the village calf being done sparsely, and by valvular punctures, only in order to avoid alarming the owner thereof and left with him until the vaccinia develops, when the vaccinator comes and operates on the village children and inoculates calves belonging to the neighbouring villages. In Berar, as in the Central Provinces, the system of calf-inoculation is pursued after the German method except that humanized lymph appears to be entirely used after the fifth generation; Lanoline paste is prepared after Dr. King's directions, but calf-to-arm vaccination is preferred as being less expensive. In Bombay the principal Depot is worked on the "true" animal vaccination system, a large stock of calves (cow) being kept on hand, so that before inoculation a calf remains under observation for not less than a fortnight; pure calf lymph is alone used for inoculation; and preserved in capillary tubes sealed at either end in glycerine, the tubes being either hermetically sealed, or without the application of heat. Inoculation is done after Warlomont's method; the stock is renewed by half yearly supplies of bovine lymph from the National Vaccine Institute. At all the city stations vaccination is done direct from the calf, and preserved lymph is sent out on requsition. The Madras Report for 1892-93 describes in detail the process of preparing glycerine pulp at the principal Depot, situated in the Presidency town, from which we learn that the pulp scraped from vesicles (96 hours old) is mixed with rather more than its weight of glycerine, the mixture reduced to a uniform paste, is stored in glass tubes (Saigon pattern), previously sterilized and closed at the ends with bees' wax and cotton, each tube containing stuff sufficient for the vaccination of ten persons; when the supply of tubes runs short, the preparation is stored between plates of glass joined at the edges with bees' wax. The Depot Officer recommends this stuff as being superior to the Lanoline paste. A noteworthy feature of the majority of the systems of animal vaccination detailed above is the obvious attempt at simplifying the whole procedure; in fact, as with the arm-to-arm system so with this, the general desire seems to be to show that the technique can be rduced to such simple proportions, that it may be easily worked out with success by any ordinary vaccinator; and in spite of the cautious expressions of opinion by some sanitary authorities, the advocates of the system have very nearly succeeded in their desire,—but by varied means. Thus, while our esteemed President and others, who are working on the economic principle, have demonstrated the feasibility of carrying on ani-

mal|vaccination with preserved lymph of one kind or another, others have arrived at the goal by introducing a general system of animal vaccination into the villages, and carrying on the work with fresh lymph. If the extensive use of preserved lymph does not, in the opinion of its advocates, require higher qualification than a knowledge and practice of the mere manual trick with the scarifier, (and in Bengal, even that is not considered necessary,) it still has its inherent dangers as shown above, and they can be easily recognized, if the fact is not lost sight of that in proportion to the great difference in general enlightenment and education between European countries and India, is there also the difference between the professional qualifications of their vaccinating staffs. Again, it is as well to remember that the principal factor in the system is a living being, deprived of its natural liberty, and, like the human vaccinifer, prone to vicissitudes of health which are more emphasized in this country than elsewhere, and which, from the experience gained in Bombay, would appear to be by no means as rare and insignificant as the absence of all mention, as to the means adopted for the efficient and thorough examination of the animals by veterinary experts, would seem to indicate. The archaic simplicity of the system of carrying on animal vaccination in villages would be worthy of all praise and imitation, if there was any assurance that it involved no deleterious consequences. Have the advocates of antiseptics, which have to be so copiously employed in all the technical details of animal vaccination, been the dupes of morbid phantasms? And what are the qualifications of men who are to be entrusted with these operations? The answers are self-evident and need not detain us. Now, I believe, that the Bombay Depot is as large and important as any other in this country, with respect to the cultivation and provision of bovine lymph for purposes of direct vaccination. About 700 calves are used annually and they are carefully examined by veterinary Inspectors before admission. Figures extending over only 3 years show that, during this period 397 calves had to be rejected on account of cattle disease, 143 being "inoculated" ones, and 234 otherwise. To what extent vaccination work which goes on throughout the year, must have been hampered, can be better imagined than described. The worry and anxiety involved are of course to be attributed to the desire to keep the strain intact, for nothing could be easier than to renovate the stock by retro-vaccination as is done elsewhere. Anyhow it may be assumed that the Western Presidency is not singular in the condition of its cattle; but what is singular and significant is, that in provinces where calf-to-arm vaccination is carried on in villages, nothing is said as to the necessity for the careful examination of the calves *before* inoculation and *before* taking lymph from them. Indeed, one authority, while recommending this system for adoption in his province, declares that inoculated calves do not require to be looked after; whether they require a preliminary examination at all, is

not mentioned. It is, therefore, conceivable that vaccination might have been done with the lymph of calves suffering from any infectious disease and, it would be interesting to know, with what results. Thus we know that "epizootic aphthæ" is widely prevalent and so is oftentimes rinder pest; what would be the consequences of vaccination in such a case?

10. (6) *Themethods of operation.*—As the object of the vaccinator is to raise a vesicle at the site of every insertion, and at the same time not to frighten the guardians of the child operated upon, much ingenuity has often been exercised in devising instruments calculated to serve this double purpose. But the development of a vesicle depends as much, or even more, on the quality of the virus than upon the nature of the instrument; and less upon the latter than upon the skill of the operator. In spite of variously constructed instruments, the old-fashioned bleeding lancet still holds the fiield, and the method of operation generally is by a single valvular puncture, three being done on each arm, but some communities object to an even number. Extended observations and experience have, however, shown the desirability of producing a larger vesicular area than is possible with the single puncture. Accordingly, since the last few years, primary vaccination, except under very unusual circumstances, is being performed in the Western Presidency by multiple punctures, a central valvular puncture with smaller punctures all round. It is, however, obvious that with preserved lymp of whatever consistency, the puncture method of operation does not yield satisfactory results. Buist says that "the storage of lymph in any way whatever, and even for the shortest period, exerts an injurious influence upon its activity rendering a more severe operation necessary to ensure the desired success." Thus it has been seen that, whereas fresh lymph, inoculated by 4 single scratches, one-third of an inch long and three-quarters of an inch apart, will produce 4 good sized vesicles leaving an aggregate cicatricial area of half an inch square, the same lymph, after only half an hours storage, necessitates the making of 40 light scratches to obtain the same result. Animal lymph is even worse than humanized lymph in this respect. Latterly, the use of preserved lymph has brought into fashion the employment of various scarifying instruments. Dr. King's scarificator resembles Weir's rake, but is simpler and less complicated in its mechanism; there is also the Berar scarifier, invented by Dr. Little; it is simple in its construction and consists of four needles fixed in a handle; both these instruments are made in this country, the object being to make cross scarifications without much trouble. In Bombay, all operations on adolescents are invariably performed by cross scarifications by means of the double edged scalpel, although fresh lymph is employed. There is no question as to the satisfactory character of the results. On whatever theoretical principle the protection afforded by vaccination may be explained, the evidence is in favour

of the greater protective power which results in three or more scars of an aggregate area of not less than a square inch. It would thus appear that, unlike other bacteriological phenomena, the degree of protection is proportionate to the number of bacteria inoculated, and the toxin produced by their growth at the seats of inoculation. The observations of many eminent men like Marson, Gayton, and others have proved the same fact by the susceptibility to post-vaccinal small-pox as seen in small-pox hospitals, and Shirley Murphy has demonstrated it, though on a small scale, by observing the course and development of revaccination.

11. *Resulting success.*—The following table gives the percentages of success in both kinds of operations in the different Provinces the figures being averages for the last five years :—

	Bengal.	N. W. Provinces.	Punjab.	C. Provinces	Berar.	Lower Burma.	Upper Burma.	Assam.	Madras.	Bombay.
Primary Vaccination	99·43	92·61	95·24	96·3 4	95·4	85·89	84·46	91·26†	94·9	94·97
Re-Vaccination...	40·83	57·61*	54·06	80·33	28·8	58·19	74·44	82·90	76·8	61·29

*Average for 4 years (1889-90 to 1892-93) †Average for 4 years (1890-91 to 1893-94)

(To be continued.)

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(*Concluded from page* 127).

12. From these it will be observed that the success rate in primary operation varies from 84·46 to 99·43 percent. and in revaccination from 29·8 to 82·90 percent; the best result in primary vaccination is seen in Bengal; and the lowest in Upper Burma. In according Bengal the first place it must, however, be noted that the ratio is calculated after excluding the "unknown" cases, a process which would naturally raise the percentage. There is, however, some fluctuation in every province and although in one or two solitary instances the quality of lymph (preserved) has been saddled with the responsibility of indifferent results, there is no attempt to showwhy there should be variations when the strain in use has been of a uniform character. The partial or complete failure of a vaccination depends on several causes, and nothing brings the operation into so much disrepute, as failure; for with ordinary care, we are told by authorities, like Marson, Sheppard and others, that there should not be more than one failure in 150 operations. Marson himself vaccinated on 1000 cases with only a single failure and Sheppard without even one in 2000 cases, and Dr. Cory's success at the National Vaccine Institute is too well known to need mention. As far as arm-to-arm vaccination is concerned failure is indicative of carelessness on the part of the vaccinator—selection of lymph and attention to the health of the child to be operated upon being the most important part of his duty. Buist has particularly laid stress on the deterioration of the strain, which follows the use of lymph taken from flabby children or those whose health is below par even if there be absence of any specific constitutional discrasiæ. In justice to the vaccinators, however, it must be said that if

*Read at the Indian Medical Congress.

they were to adhere strictly to the rules which hedge round them, the number of operations would fall woefully. If the complete failure of an operation is undesirable even under the most favourable circumstances the occurrence of partial success or of spurious results is a real misfortune, particularly in this country. It cannot be too often brought home to vaccinators that spurious results give a false sense of security, and that the mistake once committed can only be rectified after much anxious care. If there is no constitutional discrasiæ, the most effectual remedy would be Bryce's test by means of good active lymph. Indeed, it used to be the opinion of some authorities that a good and efficient vaccination could be effected only once in the life time of an individual; we now know better, and do not despair of giving the full measure of security against Small-pox; but what can be expected from the kind of men who work as vaccinators? Those whose duty calls them to inspect their work must have often come across cases, in which a fairly normal looking vesicle having been developed on the day week after operation, the 'marks' become blurred after a time, thus—showing evidently that the substance of the skin was not sufficiently touched. It is, therefore, of the utmost importance that the vaccinator should be able to differentiate between such superficial vesicles and those which leave the classical, foveated scars often seen on the arms of Europeans. Even at the risk of prolixity, I can not refrain from quoting from a report of the North-Western Provinces an extract showing how vaccination marks can be definitely described and classified :—

(1) Number of vaccination cicatrices..... (a) Depressed. (b) Not depressed. (c) Puckered (d) Glazed (e) Undefined in margin.

(2) Their collective area.

(3) The fractions of foveated cicatricial area.

The classification laid down in Form V, No. XI, (English) adopted in this country, leaves much to the individual opinion of the inspecting officer, and cannot ensure uniformity of standard; the most curious feature of the classification is the inclusion of the term 'middling' which as an index of the protective power of a vaccination is rather hazy, if not unscientific. None of the Provincial records shows the percentage of 'insertional' success which, I venture to think, is the only criterion whereby the skill of the individual vaccinator can be gauged. We know that an operation may be successful in the sense that it has not entirely failed, but whether the full expression of the desired effect has been secured can only be judged by noting the development at the site of each insertion. It is, therefore, as necessary to know this as the 'general' percentage of success. Vaccinators in this country can not be too well impressed with the importance of securing a complete insertional success

although it is now recognized in Germany that even a single good vesicle gives protection for a time ; for the condition of that country with its compulsory revaccination is widely different from that of India. The report of the National Vaccine Institute in London for 1887 88 gives the rate at 96·3 ; in the Presidency Circle at Bombay I have been keeping a record of it and find the percentage of insertional success to be only 77-95 in 1893-94, as against 80·11 in the preceding year ; this low percentage is however due to variation in the quality of lymph from cattle disease which is so prevalent in this country.

13. Although primary vaccination has yet to go a long way before it comes to be universally adopted in this country as the only harmless method of protection against small pox, it would not be out of place to observe what progress revaccination has been making in the different Provinces. From the following statement which gives the proportion of revaccination to 100 primary operations in each province it will be noted that the ratio varies greatly. It being now recognized that a revaccination at about the age of puberty gives, for all practical purposes, lasting protection against small pox (and the statistics of the Prussian Army, as given in Dr. Edwarde's pamphet, are sufficient evidence of the fact) it is interesting to see that in some of the Provinces at least the energy and zeal expended in this work has been a little too remarkable, viz:—

	Bengal.	N. W. Provinces	Punjab.	C. Provinces	Berar.	Lower Burma.	Upper Burma.	Assam.	Madras.	Bombay.
Ratio of Revaccinations to 100 Primary vaccination in 1892-93 ...	0·55	2 23	44·44	10·45	43·33	33·23	5·09	5·04	5·19	6·35

In the Punjab reports it was officially noticed that revaccinations were performed on youngsters 1-2 years after the primary operations, and would appear to have been repeated at intervals!! Theoretically, of course, early revaccination, and even its repetition, would be justified until the susceptibility of the individual was completely exhausted. Some remarkable experiments made in Dacca Jail in 1892, sufficiently illustrate the oft recurring susceptibility of the human system to vaccinia, not only when it has been recently protected by an efficient vaccination, but even by an attack of smallpox. It appears that 3,465 prisoners were successfully vaccinated, of whom 1,667 had been protected by variolous inoculation, 197 had had small pox, 1,447 had been previously vaccinated with success, and 156 were unprotected. At first 2,719 were successful of these 2032 were once more operated upon and 1303 "took." Vaccina-

tion was also performed with success on 14 prisoners, one month after recovery from small pox. These facts do not of course indicate the necessity for repeated revaccination, which would be obviously impracticable, for susceptibility to vaccinia does not necessarily mean the existence of a susceptibility to variola. The popular idea that a successful revaccination, successful in the sense that its development approaches very nearly the typical appearance of a primary operation, is indicative of the renewed susceptibility of the individual to an attack of small-pox, is based on a misconception of the relative capacity for reaction of the two viruses on the human system. As McVail has lately shown from Layet's tables given in the Bordeaux Report and Dr. Barry's report, the resistance of the vaccinated to an attack of smallpox outlasts his resistance to revaccination.

14. *Revaccination amongst mill hands necessary.*—So long as primary vaccination has not been made compulsory throughout the length and breadth of the land, it is premature to hope that revaccination will be promoted by legislative enactment. But that need not deter the Congress from expressing its opinion on the desirability of encouraging revaccination by means nearly as efficient as if they were enforced by law. Suggestions have been made from time to time by various provincial and district officials urging the expediency of enforcing revaccination on all children who attend grant-in-aid schools; and some effect seems to have been given to them in Berar. Others, like myself, have suggested the necessity of including a clause in the Bye-laws of the Factory Act whereby all operatives would be subjected to revaccination on entering upon their duties, unless they showed distinct marks of smallpox or produced certificates of a recent vaccination. Since my appointment in Bombay, my attention was drawn to the frequent prevalence of smallpox among mill hands. As Bombay is at once a great emporium of commerce, and contains a factory population of nearly $\frac{3}{4}$ of a lac, it is obvious that every fresh importation of smallpox finds a sufficient nidus in this community for its propagation, for the two principal factors, which, according to Hirsch, determine the recurrence of small-pox epidemics are (1) the necessary number of persons susceptible of the morbid poison, and (2) the introduction of the virus itself; and both these being to a certain extent present, the matter for congratulation is that small-pox does not spread and assume a serious epidemic form. This is of course owing to the infantile population being mostly vaccinated. During the present year it was noticed that more than $\frac{1}{3}$ of the cases were among adults, most of them probably indifferently vaccinated in their native villages. My suggestion was that, as rules had been framed for the observance of hours of work, and of holidays, for the prevention of accidents and for the payment of wages to the employes, the addition of another which would compel a new employe to produce a certificate of revaccination, *before* being paid his or her first wages, ought not to act

as a hardship at all, since such a rule has been in force in all Government Departments for several years. The Mill owners' Association, when addressed by the Bombay Government on the subject, expressed their inability, in the face of existing competition, to help in the matter, unless Government made it obligatory by legislation. The Government of India also declined to take any action, as any legislation in that direction would partake of the nature of class legislation which it deprecated; I was however, glad to see that a suggestion made on similar lines by the Sanitary Commissioner of Bengal was listened to with more sympathy; and I would very respectfully urge upon the Congress to express an emphatic opinion on the subject in view of its importance as a hygienic measure.

15. (C) *Progress of vaccination.*—In noting the results of vaccination in their bearing onthe incidence of small-pox it is desirable to observe, (1) the proportion of infants protected to total births, and (2) the proportion of the vaccinated to the total living population. The figures in the following table show, side by side, the percentages of protected births, actual and estimated, in the different Provinces:—

	Bengal.	N. W. Province.	Punjab.	C. Province.]	Berar.	Lower Burma.	Upper Burma.	Assam.	Madr	Bombay.
Actual ...	12·5 *	24·99	80·0 * †	78·89 *	84·11	23·66	...	26·89	31·1	80·12 *
Estimated...	11·4	22·5	50·5	53·5	66·4	14·2	13·7	18·6	18·1	56·0

Comment on these would be unnecessary when compared with corresponding figures in Great Britain; in England, the average percentage of births, unaccounted for, from 1872 to 1890, was 7·8 in the metropolis and 5·1 in the rest of England; and in Scotland, it was only 2·1. The, difference in the percentages marks the difference between birth Registration as it is and as it ought to be. If vaccination is to do any good it must protect the whole of the infantile population as it comes into existence, and this would be possible only if birth registration and vaccination were under one agency. It need hardly be pointed out that, if any body is really interested in finding out births it is the vaccinator.

16. The proportion of the vaccinated to the total—living population is given in the accompanying statement marked (I) and figures, are also given to show the ratio of deaths from small-pox. It is curious that in only one province, viz Berar, is the gradual reduction of small-pox

* Deducting deaths under one year. † For 1889-90.

fatality in proportion to the increase in the vaccinated community well-demonstrated. It is also seen to a certain extent in the N. W. Provinces, Punjab, and Burmah. A careful scrutiny of the statement does show that the averages for the quinquennials are sometimes affected by occurrences of epidemics, but that does not sufficiently explain the odd relation indicated by a decrease in the number of vaccinations being accompanied by a reduction in small-pox and vice versâ. If it were permissible to speculate on the probable causes of this inexplicable state of things, would it be impertinent to ask how much of it might be due to the large proportion of births "unaccounted for" and how much to the qualitative and quantitative character of the vaccination prevalent in this country? As an adjunct to this statement, I beg to append another marked (II) which gives the same information with respect to the City of Bombay extending over a period of 36 years. In view of the peculiar position of Bombay the difference in the occurrence of smallpox *before* and *after* the compulsory vaccination Act came into operation is most noteworthy.

17. *The administrative aspect* of the vaccination systems is as interesting in its varieties, as in its indication of the manner in which the Department tries to meet the requirements, and overcome the prejudices of the people in the various Provinces; a special para is included in some of the administration reports in which "the attitude of the people towards vaccination" is referred to; this in itself is an evidence that public confidence has not been as firmly established in this beneficial measure, as its true value deserves.

18. Judging by the proportion of the vaccinated to the general population given in the table, referred to above, it may at first sight appear that in some of the Provinces, where vaccination has been, comparatively speaking, lately introduced, it has made greater progress than in the older ones,—Coorg, the Punjab, Central Provinces, and Berar being cited in illustration of the first, and Bombay, Madras, and Bengal as examples of the last. But such is really not the case, for the proportions are calculated on the sum total of the successful operations performed, which include revaccinations, and we know how revaccination has been pushed on in some of the Provinces. The Western Presidency even although the first in the empire to obtain the benefits of vaccination, both human and bovine, has had to yield the palm to her younger sisters although in that Presidency there is not even the excuse of a lurking prejudice in favour of smallpox inoculation, which exists in most of the others, even to this day. It is of course easy to understand that a conservative people, apathetic and indifferent to everything, that does not bear directly on the life of the individual ,should be reluctant to give up the indigenous method which had, at least, the authority of an immemo

rial "rite," shrouded like everything else, in superstition, and which the skill of operators had deprived of half its terrors, if not of all its virtue it is also not difficult to conceive why an extremely orthodox people, born with a herid etary conviction in the sanctity of caste, should look with suspicion, if not with mistrust, on the introduction of a system which apparently aimed at levelling down all differences by the interfusion of "humours." But what is strange and disappointing is that the people during all these years should not have become fully alive to the palpable advantages of vaccination over the older system. Has the occurence of small pox after vaccination, i.e. what has passed as such, to do anything with this unbelief? We know that good and efficient vaccination affords sufficient protection to the individual, until its protective power has been dissipated by age, by the intensity of epidemic influence and by certain other conditions. But what is the guarantee that the vaccination in all cases of so called post-vaccinal small-pox has been qualitively and quantitively what it ought to have been? We must not forget that with the common people every thing, which has developed at the site of the operation passes muster for vaccination, and it is easy to see that small-pox subsequent to what is really no vaccination, should be put down to the inefficiency of the operation as a prophylactic.

19. *Seasonal Vaccination.*—A noteworthy feature of the vaccination system is that in almost all the Provinces, except those of Bombay and Madras, the work of vaccination is seasonal. In some provinces the season commences in September and ends in March, in others it begins and ends a month later. I venture to think that, in some districts of the Bombay and Madras Presidencies, the heat is almost as bad as anywhere else in the country, but the work is continued throughout the year; and experience has shown that with the exercise of the precautions, which are at all times necessary for the efficient performance of even such an insignificant operation as vaccination, the fears entertained about the deleterious influence of heat on the activity of lymph are exaggerated. An additional reason for pushing on the work during the hot season is the fact, that small-pox generally breaks out, or at any rate, rages with virulence at this season. The season's work is started with the supply of tube-lymph to the vaccinators, and this is then extended from arm to arm in provinces, where that system is prevalent, as in Bengal, the Central Provinces, and in some parts of the N. W. Provinces. In Assam, the whole work is carried on with "preserved" bovine lymph, supplied in tubes, the vaccinators, only furnishing humanized lymph to head quarters for retrovaccination. It is curious that the only form of preserved humanized lymph used now-a-days is that which is stored in capillary tubes; although dry lymph (*points*) is still considered in some quarters as the safest and most

reliable form of preserved lymph, because in that condition the development of spores is prevented.

20. *Vaccinating agency.*—Most of the work is carried on by departmental vaccinators; in all the provinces, except Bombay and Berar vaccination is also done at Medical institutions. Whatever else may be said about it, the retention of the entire control in the hands of a responsible department has the advantage of ensuring uniformity in work and discipline. But we find that there is a growing desire to decentralize it; and, in some provinces, the immediate supervision over vaccinators and Inspectors, and even their punishment, seem to have been left entirely to Municipal and Local Boards. Local self government may be ideally a very estimable institution, and, no doubt, it is when carried out on right principles. But those who have experience of vaccination work in Municipal towns, know that the so called enlightened citizens, who are of course generally on the municipal board are *the* people who are reluctant to encourage vaccination in their families, except under pressing necessity.

21. Besides the regular departmental hands, the work is carried on in some Provinces by licensed and private vaccinators. In Bengal and Assam the licensed, and in Burma, private agency is employed. Whether the licenced vaccinator is a retired employe of the department or an ex-inoculator, or what his qualifications are, is not clear, but that he figures largely in Bengal is evident from the fact that there are 2,620 licensed vaccinators to only 419 paid ones. He charges two annas for his operation. But a more uncommon feature of vaccination in this province is the fact that it is done to a considerable extent by *unlicensed* vaccinators, who are probably dismissed servants of the department. In Burma an attempt has lately been made to instruct the inoculators, 'Sayahs' as they are called, in vaccination and to engage them as departmental subordinates, or allow them to work privately. It is to be hoped that they do not practise their old calling under the garb of vaccination. Licensed and private agencies are no doubt cheap, but unless a very strict supervision of their work is assured, they are apt to prove too costly in the interests of vaccination. It would be too much to expect that private vaccinators, and for that matter, even licensed vaccinators, would be amenable to strict departmental discipline; but even if that were the case, it is obvious that the quality of work would suffer from the very nature of their position Those who possess practical experience of the work, are aware that one of the great difficulties of vaccination is the propagation of a material, which remains perfectly clear for a time *after* being stored and then becomes opaque, in which condition it is looked upon as imperfect; they know also that, instead of becoming opaque after storage, it may exude as such from the vesicles on the arm under certain conditions

and then it sets up violent local action, and by the absorption of the spores, contained therein, is accountable for the appearance of periodic secondary eruptions, often seen after vaccination. The successful propagation of a perfect material is, therefore, regarded as the first duty of the vaccinator, but it depends on a chain of circumstances, one of the links of which may fail at any point and vitiate the whole proceeding; thus either the children, though not positively unhealthy, may be slightly below par, the vesicles may be irritated or injured during their progress, the operation may have been unskilfully performed, or some inter-current complaint may have come on; any one of these may be fatal to the production of clear lymph, on which depends the integrity of the work. If difficulties are experienced in the execution of their duties by regular subordinates of the department, surrounded as they are with checks and safe guards from their superiors, would it be presumptuous to be sceptical about the ability of licensed and private vaccinators in this country to do the work satisfactorily? It does not need much strain of imagination to see that, where a man of the educational and intellectual status of our vaccinators has to depend for his living on his fee, he virtually puts himself out of court, so far as efficient and thorough vaccination, such as we know it to be, is concerned; he is not the man to insist that the operation shall be performed according to the regulation-standard, nor can he count upon securing lymph of the right quality. We may leave out of consideration the serious consequences which would follow vaccination, performed in this fashion. Even in England, where vaccination is pretty largely carried on by private agency of a superior kind, i. e., by qualified medical practitioners, we learn that insusceptibility to vaccination is found to exist in a larger proportion of their cases than the experience of the authorities in charge of the Public Vaccination De partment and of eminent vaccinators teaches us. Thus in his report for the year 1887-88 Dr. Cory says that of more than 38,000 primary operations, performed by him, it only once fell to his lot to fail twice at an attempt at vaccination. I, therefore, venture to think that the time has not yet come when the Government agency could with safety and propriety, part with any portion of its responsibility by licensing and otherwise allowing men, other than departmental subordinates, to do the work of vaccination.

22. *Compulsory Vaccination.*—One of the most important features of the vaccination system, from an administrative point of view, is the difference which exists between one province and another in the application of the machinery of the law to compel the vaccination of children at an age when small-pox fatality is known to be exccedingly high. The following figures show to what extent the vaccination Act is applied in each of the provinces.

	Bengal.	N. W. Province	Punjab.	C. Provinces.	Berar	Lower Burma.	Upper Burma.	Assam.	Madras.	Bombay.	Coorg
Towns and Municipalities ...	140	82	7	7	*	19	8	9	52	2	5
Cantonments	16	...	...	...	...	...	4	...	6	...	...

23. The Western Presidency stands pre-eminently as the only province in which the compulsory vaccination act is scarcely applied, for, excepting the cities of Bombay and Karachi, the work in the whole province is done without any legislative support; nevertheless, it can not be said to be any bit less efficiently or zealously done, as will be seen from the average work of th vaccinators and particularly the high proportion of births protected. The strain on the vaccinators is, however, very great, and it is to be hoped that the District Vaccination Act, passed last year, may not long remain on the statute book in a state of suspended animation. If the compulsory vaccination act is not to be made into an instrument of torture to the poor people, or of extortion for the benefit of unprincipled vaccinators, I would suggest that it should go hand in hand with animal vaccination. This may be more expensive than the present arm-to-arm system but, if carried out on the Berar method, with sufficient attention to details, both veterinary and hygienic, the results will be satisfactory. The application of the Act, however, is necessary not only to overcome the objections and prejudices of people in certain places, but it is equally necessary to stir up those, who, believing in the benefits of vaccination, are too blind to their genuine interests to take timely precautions against small-pox. Whether the neglect is due to one cause or the other the result is the same, and those who plead for this "liberty of omissional infanticide" must be made to learn that they have no business to endanger the life of others by their apathy and indifference.

24. *Female Vaccinators*:—It is noteworthy that mention is made of the employment of female vaccinators in only two provinces; in Bengal there was one Eurasian, and in Madras there were 8 natives. The necessity for the employment of female vaccinators is not very obvious, unless they are to be employed in the vaccination of Pardah Ladies; of course there is no reason why females should not be employed for the work. At the London National Vaccine Institute, I believe they have

* Proposed to be applied to all the Municipalities but not enforced.

a female attendant whose duty it is to prepare the children by the time the vaccinator comes round so as to facilitate work. If need hardly be said that the employment of trained women for such work in this country would be very advantageous; for among the many causes which endanger the success of an operation, by far the most usual are the dirty condition of the children, and the extreme haste with which they are covered up with filthy rags and carried away, to say nothing of the anxiety to wipe off the wounds on the slightest appearance of blood as soon as the operation is finished.

25. *Rewards for Vaccination.*—Lastly, the system of giving rewards to vaccinators which prevails conspicuously in the Berar and N. W. Provinces, deserves to be mentioned, if only to show what real interest the Sanitary authorities there take in promoting vaccination. The pay of this really hard worked class of public servants ranges from Rupees 8 to Rupees 24, inclusive of travelling allowance, for, excepting Municipal and Cantonment vaccinators, every one has to travel from village to village; the average area of each vaccinator's range is given only in one of the Madras Reports and appears to be 349 square miles. The average strength of population looked after, as also the average number of persons vaccinated by each vaccinator, in the different provinces is, however, given in the following statement.

	Bengal.	N. W. Provinces.	Punjab.	C. Provinces.	Berar.	Lower Burma.	Upper Burma.	Assam.	Madras.	Bombay.	Calcutta City.	Madras City.	Bombay City.
Average population per vaccinator ..	25528	57216	67834	48762	65842	71671	104724	26074	43483	49536	19591	18855	102720
Average No of persons vaccinated by each	632	1349	2747	1740	3316	2402	2363	927	1367	1794	406	1031	298

Although the average amount of work pervaccinator varies in the different provinces, still it is undeniable that, except in Bengal, the work turned out is fairly proportionate to their wages. At any rate, in view of the great importance of the work, the care and skill required to perform it, and the necessity for the constant exercise of a sufficient degree of vigilance to prevent evil consequences, it will, I venture to hope, be admitted that the labourer is worthy of better wages than he actually receives. A better class of men might be induced to enter the Department if the emoluments and prospects were alluring enough; the

pay of the upper subordinates varies from Rupees 15 upwards. How is it possible to get men possessing a sufficient amount of technical education to effectively check and supervise the work of the vaccinators on such low salaries? A majority of these men are perhaps as uneducated as the men whose work they are called upon to inspect, as many of them have risen from the ranks. If financial considerations stand in the way of reform, there is at least one course open to the authorities; I mean the establishment of classes for the instruction of Inspectors, vaccinators and apprentices. An experience of 5 years has shown me that this is of the utmost importance if the authorities desire to raise the standard of their work; and it were well the matter engaged their attention before antivaccinationists extended the field of their operation to this country. For one of the bugbears with which they prejudice simple-minded folks against vaccination is the probability of the inoculation of syphilis and other diseases through this operation. That these faddists are always on the watch to extend their propaganda is certain, for I recollect that, when the District Compulsory Vaccination Bill was under discussion at Bombay, some of the non-official members of the Council were flooded with anti-vaccination literature. The manual skill with respect to the operation itself is, in my humble opinion, of less importance than the philosophy of the procedure, although no doubt it counts for much in the use of preserved lymph, and the technique of animal vaccination generally; but even in this a great deal centres round the developed vaccinia and the vaccinifer. Some practical instruction in the technique of animal vaccination seems to have been given in Bengal, Berar Bombay, and Madras; but I plead on behalf of the men who are called upon to do arm-to arm vaccination, and here, if any where, a better knowledge of the subject than is at present possessed by this class of men, is certainly requisite. In connection with the evil effects following vaccination alluded to above, I find that none of the Provincial reports, except that of Bombay, contains any reference to them.

26. *Financial.*—A review of the vaccination systems, such as this paper lays claim to, would hardly be complete if no reference were made to the manner in which the department is supported in the different Provinces. However, much the provincial reports may vary in the supply of information and details of a technical character, there is a remarkable uniformity in their financial statements. There is much diversity in the sources from which the department is financed in the different provinces; thus:—Provincial Funds are the mainstay of the department in all the Provinces except Berar and Burma, where it is entirely maintained out of Imperial Funds; but Bengal, the N. W. Provinces and Bombay come in for a larger share than the others. Local Funds are utilized to a much larger extent in Madras and Bombay than elsewhere, and Municipal Funds

contribute towards the expenditure more liberally in these provinces than in Bengal and the N. W. Provinces. In Bengal, the Local Fund Contributiion is nominal. The Native States of the Bombay Presidency appear to spend much more on vaccination than in any of the other Provinces. The following figures show the cost per successful case in each province :—

	Bengal.	N. W. Provinces.	Punjaub.	Central Provinces.	Berar.	Lower Burma.	Upper Burma.	Assam.	Madras.	Bombay.	Coorg.
Cost per successful case 1892–93.....	0-1-5	0-2-7	0-1-9	0-2-0	0 2-7	0 4-2	0-2-10	0-1.6	0.3.8	0.5.8	0.3.10

27. *Ideal Sanitary Department.*—Since vaccination and sanitation have been linked together in this country under one direction, and it is through the vaccinating staff that the Department may be said to keep in touch with the country, any measure of reform which is calculated to improve the tone of the former is likely to react beneficially on the work of sanitation generally. Tht Department is at present so constituted that the gulf, which seperates the Commissioned administrative agency from the subordinates, is wider and deeper than in any other department of the public service, and it could not be otherwise, knowing as we do, the kind of people with which the department is generally manned. Nevertheless, it appears from several reports that on the outbreak of cholera or any other zymotic diseases, the vaccination staff is detailed for duty, in a medical capacity. It is obvious that their rank ignorance can hardly make them useful agents in the performance of this work. Without even the pretext of a knowledge of the practice of medicine, to say nothiug of its science, without the barest inkling of the rudiments of the laws of health, let alone the prevention of disease, nay without even a decent knowledge of his mother tongue, English being, out of the question, behold a representative of this class of ignoramuses stalking forth in all tbe glory of Æsculapius, trying to cure the most virulent of infectious diseases by means of remedies, of whose composition he knows nothiug, and of whose action on the human economy he knows still less! What possible good can accrue from his amateur medication is known only to the authorities, if he does not hurry the poor patients on

the road to eternity by his meddlesomeness, and in his anxiety to do something, that is about all that could be expected of him. It seems also that the supervising staff in some of the Provinces are required to submit inspection reports on the sanitary condition of the smaller towns and villages; the idea of these men, who have generally been promoted from the ranks, knowing anything of sanitation beyond what is included in the term surface leanliness, is absurd. At all events it will, I hope, be conceded that all these extra duties are so important that the employment of a better class of men for doing them would really result in much good. An ideal sanitary department should, I think, be composed of a more intelligent class of men as vaccinators, and the supervising agency of medical men varying in their qualifications according to their emoluments; those of the highest grade, being University Graduates, would fittingly constitute a connecting link between the Commissioned administrative officer and the vaccinating staff. In their capacity as medical men their services could be further utilized by furnishing them with portable dispensaries. In spite of a goodly number of medical institutions, a considerable proportion of the village population knows very little of them; their acquaintance with the Sarkar's medical men being limited to the visits of the vaccinating staff to their villages. It is these that will be reached by the supervising agency, who will be as it were the vanguard of the Health Missioners suggested by Miss. F. Nightingale.

28. Before concluding I beg to express my gratitude to the Sanitary Commissioner of the Western Presidency for the supply of the different Provincial Reports and to the Sanitary Commissioner of Madras, North Western Provinces, the Punjab and Central Provinces, for kindly furnishing me with figures relating to vaccination and small-pox fatality, which have been incorporated into the statement referred to in para 16.

29. I must also apologise for the length of this paper which has exceeded the limits assigned to it by the Committee. Being the first attempt of its kind it may be full of defects and generalizations, which should not find room in the discussion of a scientific subject; but the subject of vaccination is confessedly of an elementary nature, and even if some of its empiricisms be dispelled by a practical demonstration of the generic relation between Variola and vaccinia, some of its curious features will still remain as knotty points for the bacteriologist of the future to solve, such for instance as, why it is that the degree of protection varies in proportion to the number, and area of insertions or "marks", why it it is that vaccinia if it is an attenuated form of variola, does not regain its original virulence after its reversion to the natural soil, and lastly why it is not possible to cultivate successfully the virus outside the animal body?

STATEMENT showing the ratio of persons successfully vaccinated per 1,000 of population as well as the death rate per 1,000 from small-pox in the different Provinces.

Years.	Bengal.		N. W. P., & Oudh.		Punjab.		C. Provinces.		Berar.		Assam.		Madras.		Bombay.		Bombay City.		Burma.		Coorg.	
	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small-pox.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small-pox.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small-pox.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small-pox.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small-pox.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small-pox.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small-pox.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small-pox.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small-pox.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small-pox.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small-pox.
1868-69	.....	.....	9·00	1·01	.....	1·36	65852	0·5	4·3	1·9	.....	.....	8·8	1·3	273363	.....	9·98	1·38	19·75	·68	.....	.....
1869-70	.....	.....	8·01	3·06	.....	3·05	98848	3·4	3·2	3·6	.....	.....	8.7	0·7	397622	21943	7·35	2·11	22·46	3·4	.....	.....
1870-71	.....	.....	8·27	·79	.....	1·55	119676	0·34	7·9	·6	.....	.....	9·2	0·5	447058	.....	10·42	0·68	51·08	·59	.....	.....
1871-72	.....	.....	8·85	1·25	.....	1·45	102035	0·19	13·0	·2	.....	.....	8·0	0·8	25·10	0·66	18·39	1·42	4·56	·63	.....	.....
1872-73	.....	.....	10·76	1·14	.....	1·36	91188	0·57	16·2	3·8	.....	.....	9·7	1·2	23·82	1·83	20·26	2·87	9·34	0·32	.....	.....
	.....	.....	8·98	1·45	.....	1·76	95520	.....	8·92	2·02	.....	.....	8·9	0·9	.....	.....	13·28	1·69	21·44	1·12	.....	.....
1873-74	.....	0·18	11·61	2·84	.....	1·47	107160	1·37	14·5	3·8	.....	.....	10·6	1·7	22·22	0·61	15·36	1·17	42·98	0·52	.....	.....
1874-75	.....	0·20	11·98	2·59	.....	0·69	112435	2·38	21·0	·5	4·20	.....	11·9	1·5	26·25	0·24	20·46	0·45	6·44	0·43	.....	.....
1875-76	.....	0·09	13·52	·75	.....	0·78	158704	2·73	24·0	·4	.....	1·1	10·4	0·8	30·11	0·21	43·97	0·38	6·98	0·26	.....	.....
1876-77	.....	0·18	16·75	·95	.....	0·59	196958	0·52	31·1	·2	.....	0·38	13·3	0·8	28·19	0·70	25·47	4·92	8·19	0·46	.....	.....
1877-78	14·79	0·13	14·74	·84	23·70	0·70	37·68	0·37	38·0	2·9	4·51	0·30	21·3	3·0	26·58	1·69	18·41	1·48	6·66	0·41	.....	.....
		0·16	13·72	1·58	.....	0·85	.....	1·47	25·72	1·56	.....	0·30	13·5	1·5	26·81	0·69	24·73	1·68	14·25	0·42	.....	.....
1878-79	18·95	0·20	14·74	3·99	22·23	2·30	37·41	2·18	22·3	2·7	6·42	0·30	14·5	1·9	22·30	0·28	16·79	0·55	9·25	0·47	.....	.....
1879-80	39·41	0·38	12·42	1·72	17·34	2·83	34·89	3·44	29·3	·03	8·00	0·37	13·4	0·6	23·15	0·07	19·39	0·74	11·79	0·74	15·0	3·42
1880-81	34·81	0·38	12·93	·19	21·41	0·52	38·45	0·69	33·9	·02	5·27	0·59	18·9	0·5	25·25	0·06	22·51	0·32	11·0	1·73	20·30	0·17
1881-82	30·06	0·40	15·59	·39	26·03	0·38	47·64	0·24	32·5	·08	8·91	0·69	17·6	0·5	27·88	0·03	22·82	0 05	11·0	0·48	24·70	0·35
1882-83	28·38	0·20	13·69	·60	23·53	0·34	36·48	0·45	38·0	·1	10·53	0·71	19·7	0·6	30·18	0·10	42·41	0·11	12·50	0·21	21·85	2·61
	30·32	0·31	13·87	1·38	22·11	1·27	38·97	1·40	31·2	·58	7·83	0·53	16·8	0·8	25·75	0·11	24·78	0·35	11·11	0·73	20·46	0·89
1883-84	27·38	0·14	12·94	3·14	31·08	0·64	36·37	0·53	30 3	1·5	15·19	1 36	22·3	1·3	31·01	0·81	21·96	1·81	16·70	0·19	22·64	1·61
1884-85	28·94	0·28	12·88	4·59	28·68	0·87	36·01	0·55	37·0	·2	18·67	1·05	23·6	2·1	30·39	0·88	22·43	0 13	39·95	1·67	47·05	0·61
1885-86	25·76	0·14	13·50	·33	29·93	0·40	32·97	0·38	35·3	·09	22·31	0·44	23·2	1·2	32·45	0·16	21·25	0·06	13·46	0·58	50·79	1·34
1886-87	29·68	0·06	14·05	·24	30·52	0·57	34·69	0·31	35·6	·04	24·04	0·12	21·5	0·6	32·30	0·05	21·78	0·02	14·69	0·03	46·33	0·24
1887-88	30·41	0·05	14·93	·19	32·36	0·87	36·30	0·38	35 2	·1	24·01	0·26	22·4	0·7	33·54	0·23	25.10	0·12	16·70	0·06	48·28	0·74
	28·43	0·13	13·66	1·70	30·51	0·67	34·07	0·43	34·28	·38	20·84	0·65	22·6	1·2	31·94	0·43	22·50	0·43	16·30	0·50	43·02	0·92
1888-89	29·51	0·09	15·14	·56	40·84	0·90	37·45	1·22	36·1	·3	25·38	0·45	24·8	0·8	34·07	0·22	24·45	0·54	19·79	0 16	37·69	0·27
1889-90	28·79	0·13	16·09	1·09	40·13	0·42	34·67	1·99	35·68	·7	24·49	0·49	26·8	1·0	34·34	0·43	24·13	0·33	26·67	0·77	45·39	0·10
1890-91	28·64	0·19	19·48	1·26	37·15	0·47	38·22	0·26	34·3	·1	26·92	0·31	28·9	1·0	33·59	0·17	25·16	0·18	24·36	0·01	40·18	0·19
1891-92	22·63	0·10	19·10	·56	33·24	0·17	35·03	0·08	36·0	·01	29·93	4·47	21·4	1·4	31·78	0·08	31·32	0·13	21·42	0·29	54 31	2·75
1892-93	24·52	0·31	20·34	·16	33·25	0·54	34·84	0·10	37·0	·02	31·51	0·29	30·4	1·3	30·71	0·15	26·29	0·66	25·79	0·32	63·80	5·27
	26·82	0·16	18·01	0·73	36·92	0·50	36·04	0·73	35·8	·2	27·65	0·40	16·5	1·1	32·90	0·21	26·27	0·38	23·61	0·51	48·26	1·74
1893-94	.....	.....	25·83	·13	37·72	0·20	33·78	0·17	35·0	·06	28·33	0·53	30·6	0·3	30·18	0·19	21·71	0·25	31·62	0·68	.....	.....

II.

Statement showing the ratio of persons successfully vaccinated per 1000 of population as well as the death rate per 1000 from small—pox in the City of Bombay. :—

Years.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small pox.	Years.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small pox.
Before the introduction of the Compulsory Vaccination Act.					
1858	6996	1714	1868 69	9·98	1·38
1859	6532	374	1869 70	7·35	2·11
1860	6760	166	1870 71	10·42	0·68
1861	7185	1627	1871 72	18·39	1·42
1862	4748	163	1872 73	20·26	2·87
	6444	809		13·28	1·69
1863	5494	1059	1873 74	15·36	1·17
1864	5696	1707	1874 75	20·46	0·45
1865	5646	567	1875 76	43·97	0·38
1866	6669	1079	1876 77	25·47	4·92
1867	8428	1055	1877 78	18·41	1·48
	6387	1093		24·73	1·68
After the introduction of the compulsory vaccination Act.					
1878 79	16·79	0·55	1888 89	24·45	0·54
1879 80	19·39	0·74	1889 90	24·13	0·33
1880 81	22·51	0·32	1890 91	25·16	0·18
1881 82	22·82	0·05	1891 92	31·32	0·13
1882 83	42·41	0·11	1892 93	26·29	0·66
	24·78	0·35		26·27	0·38
1883 84	21·96	1·81	1893 94	21·71	0·25
1884 85	22·43	0·13			
1885 86	21·25	0·06			
1886 87	21·78	0·02			
1887 88	25·10	0·12			
	22·50	0·43			

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II.

Statement showing the ratio of persons successfully vaccinated per 1000 of population as well as the death rate per 1000 from small-pox in the City of Bombay :—

Years.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small pox.	Years.	Ratio of persons successfully vaccinated per 1,000 of population.	Death rate per 1,000 from small pox.
Before the introduction of the Compulsory Vaccination Act.			After the introduction of the Compulsory Vaccination Act.		
1858	6960	1714	1878-79	0·05	
1859	6632	324	1879-80	7·88	2·11
1860	6703	188	1880-81	10·41	0·03
1861	7185	1027	1881-82	15·80	1·83
1862	4748	183	1882-83	20·26	2·37
	6114	809		13·23	1·60
1863	6101	1059	1873-74	15·36	1·27
1864	5096	1707	1874-75	20·46	0·45
1865	5616	867	1875-76	18·07	0·33
1866	6880	1079	1876-77	23·47	0·03
1867	6468	1085	1877-78	18·41	1·35
	6057	1098		21·73	1·03

1858-59	10·79	0·30	1883-84	21·65	0·84
1879-80	10·30	0·74	1880-90	24·15	0·03
1880-81	22·34	0·06	1890-91	20·76	0·18
1881-82	22·82	0·06	1891-92	31·32	0·13
1882-83	42·41	0·11	1892-93	20·20	0·88
	24·78	0·30		20·27	0·38
1883-84	21·08	1·81	1893-94	21·11	0·25
1884-85	32·43	0·13			
1885-86	31·25	0·00			
1886-87	21·78	0·02			
1887-88	26·10	0·12			
	25·60	0·40			

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